Selecting fuses

Summary of fuse selection is as follows:

1. General subjects on selecting fuses
   1.1 Electric characteristics
      (1) Applied voltage
      (2) Regular current
      (3) Current waves
      (4) Interrupting
      (5) Fuse cut-off signal
   1.2 Installation
      (1) How to connect
   1.3 Environment
      (1) Ambient temperature
      (2) Ambient humidity
      (3) Vibration
   1.4 Operating longevity
      (1) Durability and operating longevity

2. Electronic characteristics

2.1 Applied voltage
   The rated voltage of a fuse shows the maximum applied circuit voltage. A rated voltage fuse larger than the circuit voltage should be used.

2.2 Regular current
   To lower wear on fuses in the long term and to guarantee operating longevity, reduction against the rated current will be necessary. The recommended reduction coefficients for each series are as follows:

   - 250CF(35SF), 660CF(600CF), 800CF(700CF), 400KH(350KH), 600KH(600KH)
     Less than 0.5 (Regular current, AC sine wave current)
     Less than 0.4 (Pulse wave-form for inverters, power regulators, etc)
   - 250GH, 350GH, 660GH, 600SPF, 1000SPF
     Less than 0.8 (Regular current, AC sine wave current)
     Less than 0.6 (Pulse wave-form for inverters, power regulators, etc)
   - 1000GH, 1500SPF
     Less than 0.6 (Regular current, AC sine wave current)
     Less than 0.5 (Pulse wave-form for inverters, power regulators, etc)
2.3 Current waves

The effective value of current

\[
\text{Circuit current effective value} = \sqrt{\frac{I_1^2 \times t_1 + I_2^2 \times t_2 + I_3^2 \times t_3}{T}}
\]

If one cycle \(T\) is less than 100msec, the rated current of a fuse will be determined by using the reduction coefficient in 2.2 Regular current.

※ If the pausing time is longer than the operating time, the above calculation will not work even though one cycle \(T\) is less than 100msec. Please contact us for the details.

2.4 Interrupting

・ Breaking capacity

The short-circuit breaking capacity is shown on the fuse. Fuses should be used at a level below the breaking capacity.

・ Total \(I^2t\)

A combination of pre-arc \(I^2t\) and arc \(I^2t\) is specified as the total \(I^2t\). The total \(I^2t\) in our catalogue is a value at the maximum rated voltage. If a fuse is used at lower circuit than the rated voltage, please refer to the table RMS Circuit Voltage Vs. \(I^2t\) Correction Factor in our catalogue. When selecting a fuse, the total \(I^2t\) of the fuse should not exceed the \(I^2t\) of semiconductor elements.

Voltage/Current·Time at short-circuit current interruption of protect fuses for semiconductor devices
· Cut-off current
  The relation between peak let-thru value and current is expressed as the Current Limiting Characteristics. Please refer to our catalogue for the characteristics of each fuse.
· Operating over loaded voltage
  When a fuse cuts off, the high arc voltage will occur between the fuse electrodes, and this arc voltage is called the operating over loaded voltage. At maximum, this will be 2 times larger than the rated voltage.
· DC interrupting
  Interrupting operation at DC circuit is easily influenced by circuit time constant. Please refer to our catalogue for circuit voltages expressed against the circuit time constant.
· Minimum interrupting current
  Protect fuses for semiconductor devices are designed so that they do not cut off and can’t be interrupted at a low current. The minimum interrupting current depends on each fuse. Please refer to the minimum interrupting current in our catalogue. Please use fuses in conjunction with other protectors if the short-circuit current of the circuit is lower than the minimum interrupting current.
· Melting time-current characteristics
  The curves show the relation between the current and time starting from the over loaded current flow into the fuse until the fuse element cuts off. This characteristics specify its average value, and the current will be fused at ±15% in the current axis.

2.5 Fuse cut-off signal
  Some fuses have an indicator that signals interruption.

  Fuses with indicators
  600SPF, 1000SPF, 1500SPF
  Fuses that can have an indicator installed
  250GH, 350GH, 660GH
  ※ When ordering a fuse with an indicator, please put an “S” at the end of the ampere rating.

  →250GH-100S

  A switch for sending a signal electrically at the point of contact is installable to an indicator.

  For SPF series
  AMS-5VX
  For GH series
  AMS-3B, AMS-01B, AMS-7
  For details, please refer to the option in our catalogue.

3. Installation
  Our fuses are divided into 3 types: cylindrical fuses used with fuse holders, circle fuses with
L-shaped terminals fixed with screws, and square body fuses bolted at both ends. Please select the appropriate type by considering usage. Fuse holders for cylindrical fuses are also available. When fuses are installed as described below (parallel), please leave the described space to allow heat to be released.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Current</th>
<th>A (mm)</th>
<th>B (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250V</td>
<td>60A</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>175A</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>350A</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>600A</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>500V</td>
<td>55A</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>150A</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>600V</td>
<td>250A</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>660V</td>
<td>350A</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>700V</td>
<td>500A</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>650A</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>1000V</td>
<td>45A</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>120A</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>225A</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>300A</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>400A</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>600A</td>
<td>30</td>
<td>20</td>
</tr>
</tbody>
</table>
3. Environment

3.1 Ambient temperature
A high temperature test at +90°C for 150 hours and a low temperature test at -20°C for 150 hours are guaranteed. The rating of a fuse by the ambient temperature needs to be reduced referring to the following table.

![Correction by ambient temperature](image)

3.2 Ambient humidity
The guaranteed humidity-proof test is at +60°C 95% Rh for 150 hours.

3.3 Vibration
The guaranteed vibration test is at 10-30Hz for 1 minute, total amplitude 1mm 3 distances for 30 minutes per distance.
4. Operating longevity

Load factor

(A) Regular load (rectified circuit, etc)
Load factor: less than 0.8

(B) Repetitive operating and pausing.
With adequate pausing time
Load factor: less than 0.7

(C) Intermittent load current in a regular cycle (pulse current for inverter circuit)
Load factor: less than 0.6

Load factor = \frac{\text{Effective value of operating current}}{\text{Rated Current}}

- Selection standard for rated current

\[ I_N = \frac{I_{\text{rms}}}{T \times S} \]

- Rated current of fuse > I_N
  
  \(*\) Rated current of fuse \geq\) Operating current peak value

Estimated operating longevity against short-term over loaded current

Operating Pausing
The durability in load factor can be estimated for the following fuses.

- 250GH Series
- 350GH Series
- 660GH Series
- SPF Series

**Operating time**

1. Less than 100ms
2. Less than 1s
3. Less than 10s
4. Less than 100s